



Assistance à la Dynamisation de l'AgriBusiness au Rwanda

INTEGRATED MANAGEMENT OF PASSION FRUIT DISEASES IN RWANDA¹

**Anne Turner, Ph.D.
Horticultural Specialist**

Introduction

The level of disease in some passion fruit growing areas of Rwanda has risen rapidly over the past couple of years, and to the extent that producers in some regions are at risk of losing this important means of income generation. It is therefore imperative that a strategy be developed to manage disease problems in passion fruit; to be effective, this strategy will need to incorporate an integrated approach, combining a range of techniques which are applied according to each specific situation.

The following paper gives a brief summary of the most serious disease problems and proposes a combination of measures which should be adopted in an attempt to manage these problems in a sustainable and economical fashion.

Passion fruit diseases of greatest importance in Rwanda

Passion fruit woodiness virus (PWV)

First identified in Rulindo in May 2002, this disease has now become widespread in Kigali-Ngali, and has been observed from Ruhengeri to Cyangugu provinces. The primary symptom of this deadly viral disease is thickening and hardening of the fruit skin; fruit are smaller in size, and juice content is greatly reduced. Foliage often shows a yellow mosaic pattern as well as “crinkling”. Plant growth is stunted, and, depending on the age of the plant at time of infection, no marketable fruit may be produced.

The virus, which can also be present in plants of the Cucurbitaceae, bananas and many weeds, is transmitted by insects (aphids) and mechanical means, e.g. on tools used in the field. Plants can be infected by the virus yet show no symptoms as long as they are not stressed, similar to the way the HIV virus behaves in human beings. Once the plant's growing conditions become sub-optimal, due to drought, nutrient deficiency, cool temperatures, etc., the virus is manifested, and there is no solution but to uproot and burn (or otherwise fully destroy) the plant.

¹ While it is our hope that this information will be as widely disseminated and best used as possible for the benefit of Rwandan passion fruit growers, we request that it not be replicated or quoted without acknowledging ADAR/Chemonics as the source.

It is important to note that this virus has seriously affected passion fruit plantations in Kenya, and to the extent that many producers there have abandoned passion fruit production (Kyengo and Njuguna, pers. comm.).

I've made enquires of passion fruit researchers working around the world regarding the existence of PWV resistant varieties, and the consensus to date is that none exist. Hence, there is no "cure".

Rather, we need to **prevent** plants from becoming infected with and developing the symptoms of the virus, and if these measures fail, to uproot and destroy all plants manifesting this disease.

Septoria spot

This is a fungal disease which is found throughout Rwanda's passion fruit growing areas. The pathogen attacks both leaves and the fruit, producing brown spots which remain small (ca. 2 mm) on the leaves and stems, but which can coalesce to cover large areas of the fruit. Affected fruit ripen unevenly, if not rotting entirely, and negatively affect juice quality when used in processing. Even a light infection can provoke a high level of leaf and fruit abscission. *Septoria*, as with many fungal diseases, is favored by high humidity and therefore more likely to occur when plants are not properly pruned and trellised.

What makes this disease particularly troublesome, however, is that it can be transmitted by seed. Because many of Rwanda's passion fruit producers have used seed left over from fruit processing factories, this disease has been inadvertently spread and now occurs at very high levels in some plantations. Given that infection starts at a very young stage with this seed transmission, and quickly spreads in the nursery due to water-borne dispersal (and the failure of most producers to inspect for and rogue out infected seedlings), use of a fungicide – if one registered for passion fruit existed in Rwanda – would not be effective in combating this disease. As with PWV, the best approach is prevention: careful selection of fruit from which seed is extracted for seedling production together inspection and hygiene at the nursery and field level (to be explained below).

Anthracnose (Colletotrichum gloeosporioides)

This is another fungal disease which can be found wherever passion fruit is grown in Rwanda, however to a less serious extent than *Septoria*. It most frequently occurs following mechanical wounding of the plant, which provides the pathogen an entry point. Shoots may start dying back from the tips; the leaves shrivel and die but usually remain attached to the shoot.

Blackening of the middle part of the stem (usually starting from the point of infection) may be observed. Because the fungus moves towards the base of the plant, its impact can be reduced if infected parts are pruned back starting at least 10 cm below the visibly affected part, and the material discarded outside of the plantation.

Avoiding wounding of the plant will greatly reduce the likelihood of infection, along with good field hygiene practices (to be explained below).

Cucumber Mosaic Virus (CMV)

This virus has a less devastating effect on passion fruit plants than PWV, and is not as widespread, to my knowledge². Infected plants usually have distorted leaf and shoot growth, especially in the youngest leaves/shoots, which can be described as a “shoestring” appearance.

Leaves and fruit often develop ring spots (a pronounced yellow color in leaves, green to greenish yellow as fruits ripen). This virus is spread by insects (aphids) and by mechanical means; it may possibly also be seed-transmitted.

Since CMV has an enormous host range (over 1,200 plant species, including many common vegetables as well as weeds), it is difficult to control once it has been introduced into an area. Infected plants should be uprooted and destroyed as soon as they manifest symptoms of the disease. As with PWV, prevention is the key to the management of this virus, starting with careful seed selection and good hygiene at the nursery and field level.

Disease Management Techniques

As noted above, **prevention** is the key to managing passion fruit diseases in Rwanda. The following techniques, applied in combination, can greatly reduce the risk of passion fruit disease epidemics.

1. **Selection of growing environment:** if plants are given the optimal growing conditions, they are less likely to be stressed and therefore predisposed to disease development. Passion fruit in Rwanda should be grown at elevations of 1200 to 1750 m.a.s.l.; higher elevations (up to 1900) can be tolerated only if soil fertility is high and drought stress can be avoided, and careful crop management is employed. Passion fruit requires a well drained soil; therefore, valley bottoms where soils tend to be humid much of the time should be avoided.
2. **Seed selection and extraction³:** **only seed of known origin should be used.** It is preferable to select fruit from a plant which shows no symptoms of disease, grows vigorously and produces purple fruit⁴.

² The most serious level of CMV that I have observed is in Ruhengeri, although I have also seen one plantation seriously affected with this virus in Gitarama. In Cyangugu, I have found only isolated cases of CMV infection.

³ At present it is recommended that passion fruit growers depend on locally available seed, selected as described above. I will be working with ISAR to try to develop some improved lines of passion fruit, the seeds of which will be disseminated to selected producers for multiplication; once sufficient material is available, it should be disseminated to producers at large, together with instructions on how to select seed for future crops.

⁴ I have found fruit of different colors, e.g. red, in Rwanda; since these are not exportable, we discourage the producers we work with from using them for seed propagation.

In the event a producer has no access to fruit other than those on the market, only fruit which show NO symptoms of disease should be used.

In both cases, it is preferable to allow the fruit to fully mature on the plant before harvesting for seed extraction.

To extract the seed, first dip the fruit into a solution of sodium chloride (one part to 3 parts clean water); this will kill any surface borne pathogens. Cut the fruit to remove the seed and pulp. If the seed does not have to be planted immediately, it is best to ferment the seed plus fruit pulp in a closed jar for 10 to 14 days; the fermentation can eliminate propagules of *Septoria* which are on the seed coat (but not those inside the seed), and helps to soften the seed coat which facilitates germination. After fermentation, the seeds are washed, dried in the shade and stored in a cool place. The germination rate falls with time in storage, and seed stored longer than 2 months may yield only a low percentage of plants. If seed is to be used immediately after extraction, wash it to remove the pulp, dry in a shaded area then sow.

Note: *the amount of fruit needed to provide enough seed to plant 1 ha of passion fruit is 30 – 40.*

3. **Hygiene at the nursery level:** Nurseries should be located in a place isolated from other passion fruit plants, together with cucurbits and bananas. It is preferable to rotate the nursery site, if possible, or at least to change the part of the nursery where passion fruit seedlings are raised each year (being careful to destroy all old passion fruit plants first). If the seeds are first sown into beds (“germoirs”) and later transplanted to pots/other beds, it is essential to space the seeds 1 cm apart in the lines, with 10 cm between lines. Closer spacing fosters development and spread of disease. Once they have emerged and have 2 true leaves, seedlings should be “pricked out”, preferably into plastic bags/pots. The nursery should be carefully inspected **every day**, and all seedlings exhibiting any signs of disease or insect infestation removed and destroyed.

4. **Hygiene at the field level:**

- § Rotation and separation are essential to preventing disease development; new plantings of passion fruit should be **at least 50 m and upwind** of all existing passion fruit plantations. Where possible, it is advisable to plant windbreaks of species such as *Pennisetum* to reduce wind-blown dispersal of diseases and insects. All old passion fruit plants **must be uprooted and burned** once they have ceased to be productive. Land on which passion fruit has been grown **must undergo a period of at least 3 years** before replanting to passion fruit.

- § Fields should be inspected at least once a week; plants found exhibiting symptoms of PWV and/or CMV should be uprooted, taken out of the field and destroyed. Leaves/fruits/shoots with signs of fungal disease should be removed and destroyed. All fallen plant material (fruits, leaves) must be regularly collected and removed from the field. Any “volunteer” passion fruit plants, along with any cucurbits, found growing in or near a passion fruit crop must be uprooted and removed from the vicinity. “Volunteer” passion fruit should be destroyed rather than replanted in another location.
- § If aphids are found in a crop, and an appropriate insecticide is available, the crop should be treated. If no insecticide is available/affordable, a soap solution (made with soft soap, not detergent) or a botanical insecticide may be used.
- § Tools such as secateurs and knives should be sterilized, either in a 25% solution of sodium chloride, or if too expensive, a solution with a detergent such as ‘OMO’; this need not be complicated, it’s just a matter of dipping the tools into the solution between each plant. Hoes and workers hands should be cleaned after working in one field before going to the other. Ideally, the soles of workers boots/shoes should be dipped into disinfectant; however this might not be feasible for most of Rwanda’s passion fruit producers.
- § Workers should always start in the youngest plantations and move from them to progressively older ones; this will reduce likelihood of diseases/pests being carried from the older (and more likely to be infected) into the younger (and more susceptible) plantings.

5. Regular and careful pruning of the plants: one of the factors predisposing Rwanda’s passion fruit crops to fungal diseases is that **many producers do not practice pruning. As a result, the plant develops a dense, heavy canopy, humidity levels around the foliage are high and fungal diseases more likely to infect the plant.** As passion fruit producers in other parts of the world have learned, a crop will be more productive over the long run if plants are pruned regularly. In the initial stages of growth, the plant is pruned to develop a “fruiting framework” consisting of two main vines which grow up to a height of 2 m, and then trained in opposite directions along a horizontal support. Selected, well spaced secondary vines which develop from these main ones grow from the top down towards the soil (cutting them off 15 cm before they reach the soil), forming a single layered “curtain” of vines, which will bear fruit.

By reducing the amount of fruit borne on a plant at one time, the stress provoked by a high assimilate demand is reduced, and the plant is better able to resist diseases. Moreover, this stretches out the production period so that fruit is available over a longer period of time. Vines which have already produced fruit, along with old/dead vines must be pruned and removed from the field. Many producers are tempted to leave old plant materials in the field, believing them to be a source of “fertilizer”; it is better, however, to not risk leaving potentially infected material in the field where it can contaminate the crop. **While pruning is in all cases advised, pruning tools must be cleaned between plants to prevent spread of disease.**

- 6. Use a wide spacing between passion fruit plants, and intercrop where possible:** A spacing of at least 2 m x 3 m is recommended to both reduce the likelihood of disease transmission, and prevent build-up of humidity within the crop's environment. What I have observed over the years I been working with Rwandan passion fruit producers is that diseases, especially viral diseases, are more likely to occur in mono-cropped passion fruit, particularly when planted at a close spacing and in proximity to other passion fruit crops. In Ruhengeri, for example, isolated plantings of passion fruit grown at wide spacing using live trees for support are rarely found to have PWV or CMV; yet crops grown as monocultures, and planted more densely almost invariably have some level of viral infection. Intercropping with species such as beans, potatoes or sweet potatoes allows producers to use a wider spacing without wasting limited land; the increase in plant diversity may also contribute to reduced risk of disease and/or insect infestation.
- 7. Other practices to boost plant health:** As stated above, plants which are not subjected to stress of any sort will be more likely to resist disease. The following are general practices which are recommended in all situations to promote healthy growth of passion fruit:
- § Keep the soil covered with a thick layer of straw or other organic matter as mulch. This helps maintain soil humidity during the dry season, reduces splash of soil-borne diseases on the plant during heavy rains, and impairs the emergence of pests such as thrips which pupate in the soil.
 - § Regular weeding to reduce competition with the crop for nutrients and soil moisture and to remove potential alternative hosts for viral diseases.
 - § Avoid wounding the plant during field operations. Passion fruit has rather superficial roots which can be injured during cultivation if care is not taken.
 - § Provide plants with adequate fertilizer, both before planting and at regular intervals throughout the year. Well decomposed manure should be incorporated into the soil to a depth of 40 to 50 cm at least 4 weeks before planting.

Note:

The above is only a proposed strategy for reducing the likelihood of epidemics occurring in Rwanda's passion fruit crops.

Once more than 30% of a crop is infected with one or a combination of diseases, a decision should be made as to whether or not to uproot and destroy the entire crop. This decision should be based on factors such as: nature of disease (viral or fungal), how favorable the growing environment is/is not (and therefore the susceptibility of the uninfected plants), the risk the infected crop poses to neighboring producers/the region (e.g. an isolated case of a disease in an otherwise uninfected zone) and the age of the crop.

Precise guidelines for decision making need to be drawn with input from Rwandans who are knowledgeable about laws and policies in this country and the social-economic environment in which Rwanda's small scale farmers exist.